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## IS DARWIN SHORN?

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NO one likes to criticise such a man as John Burroughs. His charming portrayal of the ways and manners of our birds and chipmunks and other "wee beasties" has endeared him to all of us. We who are naturalists are grateful for his keen observation and accurate descriptions, and most of all for his refusal to be lured into the path of the nature faker that has led to the discrediting of some of our most promising writers on natural history subjects.

But the more he is admired and respected, the greater his following among lovers of good literature, the subtler his power to mislead when he goes astray. This he certainly does in his paper "A Critical Glance into Darwin," which appeared in the August number of *The Atlantic Monthly*.

In the very first paragraph he says: "It is with Darwin's theories that I am mainly concerned here. He has already been shorn of his selection doctrines as completely as Samson was shorn of his locks."

This is a rather serious statement to be made in an off-hand manner; moreover it is far from true. I believe that I have a sufficiently wide acquaintance with working naturalists of the present time and a sufficient knowledge of their attitude towards the theory of natural selection to justify this rather blunt expression.

De Vries regarded his own mutation theory as a contribution to the theory of Natural Selection. Jennings, one of our foremost protozoologists says, "Evolution according to the typical Darwinian scheme, through the occurrence of many small variations and their guidance by Natural Selection, is perfectly consistent with what experimental and paleontological studies show us; to me it appears more consistent with the data than does any other theory." Castle, one of our leading geneticists, believes in continuous variations not following a single necessary trend, but guided by selection; and E. B. Wilson, among the most honored of all American biologists, says: "And yet, as far as the principle is concerned I am bound to make confession of my doubts whether any existing discussion of the problem affords more food for reflection, even today, than that contained in the sixth and seventh chapters of 'The Origin of Species' or elsewhere in the works of Darwin."

The chapters referred to are captioned "Difficulties of the Theory" and "Miscellaneous Objections to the Theory of Natural Selection." Here Darwin has gathered together all of the criticisms that had appeared up to the edition of 1896, twenty-eight years after the first publication of the theory, and has answered them with the utmost fairness and candor.

In this connection I can not refrain from quoting from my revered teacher, Dr. David Starr Jordan. Speaking of the "Origin," he says: "There is in it no statement of fact of any importance which, during the twenty-five years since it was first published, has been proved to be false. In its theoretical part there is no argument which has been proved to be unfair or fallacious. In these twenty-five years no serious objection has been raised to any important conclusion of his which was not at the time fully anticipated and frankly met by him."

No one can dispute the authoritative position of these men among American zoologists. Numerous others could be cited, and I am confident that none of them would subscribe to the statement that Darwin's selection doctrine has been overthrown. More than this; there is no doubt in my mind that if the entire membership of the American Society of Zoologists could express their opinion an overwhelming majority would assert that natural selection as proposed and elaborated by Charles Darwin is still the best explanation of organic evolution. No discarded theory could command so great a following among professional naturalists as does this.

Mr. Burroughs objects strenuously to Darwin's statement that he saw one of the chief factors of evolution in fortuitous or chance variations, and declares: "I can no more think of the course of evolution as being accidental in the Darwinian sense than I can think of the evolution of the printing press or the aeroplane as being accidental, although chance has played its part."

Now what is "chance" in the Darwinian sense? Darwin himself gives an explicit answer at the beginning of his chapter on Variation: "I have hitherto sometimes spoken as if the variations so common and multiform \* \* \* were due to chance. This is, of course, a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of each particular variation." Nothing could be more honest and straightforward than this; and it is manifestly unfair to accuse Darwin of using "chance" as if it meant lawless or opposed to law. The friends of Darwin have a right to insist that fair-minded critics refrain from this sort of misrepresentation.

The majority of present day zoologists and botanists do not talk much about Darwinism or Natural Selection; not because they do not believe these things but because they regard them as virtually settled and have turned to other matters, particularly the mechanism

of heredity and the causes of variation, matters which Darwin did not explain satisfactorily because knowledge of these has been almost entirely the result of post-Darwinian investigation. At present most biologists believe in Mendelism and many of them have accepted as true the mutation theory. For all of these the chromosome looms so large as to obscure most of their mental horizon. I have seen a twenty-foot chart of a chromosome fully eclipse a map of the world, and thought it emblematic of the present situation.

It seems evident that a large number of our younger generation of biologists have fallen into strange confusion owing to a lack of appreciation of the difference between "variation" as used by the mutationist and the same word as used by Darwin. The mutationist uses the word in the sense of fluctuating varieties as opposed to mutations, while Darwin did not so restrict its use and, as will be shown, included what are now known as mutations in his "individual variations." De Vries, the father of the mutation theory, was entirely without mental confusion of this sort, and I can best make my point by quoting him. He says:

"Darwin discovered the great principle which rules the evolution of organisms." In discussing the steps by which progress is made he says: "On this point Darwin has recognized two possibilities. One means of changes lies in the sudden and spontaneous production of new forms from the old stock. The other method is the gradual accumulation of those always present and ever fluctuating variations which are indicated by the common assertion that no two individual of the same race are exactly alike. The first changes are what we call 'mutations,' the second are designated as 'individual variations' or, as this term is often used in another sense, as 'fluctuations.' *Darwin recognized both lines of evolution.*" The italics are mine.

What I am driving at is this. Many mutationists have become so accustomed to the word "variations" as synonymous with "fluctuations" that they assume that Darwin used the word exclusively in that sense when he speaks of individual variation as one of the main factors in natural selection. They therefore erroneously conclude that the mutation theory is squarely opposed to natural selection and in adopting the former suppose that they thus abandon the latter.

## II

The work of DeVries, Morgan, Castle and a host of other men who have gone deeply into the mechanism of heredity and have been particularly interested in the behavior of the chromosomes as expressed by the Mendelian Law, has shown very conclusively that a majority of mutations are exceedingly minute, and that they range from hardly detectable changes to the much rarer great mutations recorded of the evening primrose. The difference between fluctuations

and mutations is not quantitative but qualitative, the latter only being inheritable although they may be quantitatively no more conspicuous than the slightly different color of the eyes of *Drosophila*.

Now we must remember that all slight variations, be they mutations or fluctuations, were simply "individual variations" in Darwin's time, and both were included in his term "variations." In speaking of variability, he says: "In all cases there are two factors, the nature of the organism (heredity) *which is by far the most important of the two*, and the nature of the conditions (environment)." The words within parentheses and those in italics are mine. It is quite evident that the modern geneticist would interpret variations due to the former of these "factors" as mutations and those due to the latter as fluctuations, and that Darwin distinguished between the two so far as the knowledge available in his time permitted. He also plainly regards the mutations as much the more important.

De Vries, therefore, had keener vision than some of his followers when he said: "My work claims to be in full accord with the principles laid down by Darwin and to give a thorough and sharp analysis to some of the ideas of variability, inheritance, selection and mutation which were necessarily vague in his time." It seems quite certain that the founder of the mutation theory did not regard Darwin as "shorn of his selection doctrines."

### III

In 1903 Professor T. H. Morgan published his "Evolution and Adaptation" containing the most elaborate criticism of Darwin's work that has appeared in America. This book has won high praise and deserves it, for Morgan performed a distinct service in gathering together and presenting in good form all that could be said against Darwin and his theories. It is imposing in mass but hardly convincing in detail, giving an impression of painstaking special pleading rather than the judicial attitude which Darwin so successfully maintained throughout his work. Moreover, one has the feeling that the outcome is something of an anticlimax; because the author, if he gets anywhere, simply arrives in the camp of the mutationists, who, like their leader, De Vries, are mainly Darwinian in their belief now as they were then.

In 1903 mutations, so far as they were known, were relatively large jumps, while subsequent investigations have shown them to be entirely comparable, phenotypically, with the "individual variations" of Darwin, and they would have been so regarded by him. There was therefore a much greater apparent difference between fluctuations, or individual variations of Darwin, and the mutations of De Vries in 1903 than there is now; for these differences, so far as outwardly shown, (and these were all that Darwin did, or could deal with) have practically disappeared.

*It can not be too strongly insisted upon that the great proportion of the mutants of the present time were included in the variations of Darwin.*

At the conclusion of Morgan's work we find the following statement which is most significant from the standpoint of this paper: "Their (the Darwinian school's) opponents, on the other hand, have, I believe, gone too far when they state that the present condition of animals and plants can be explained without applying the test of survival, or, in a broad sense, the principle of selection among species." "I am not unappreciative of the great value of that part of Darwin's idea which claims that the *condition* of the organic world, as we find it, can not be accounted for entirely without applying the principle of selection in one form or another. This idea will remain, I think, a most important contribution to the theory of evolution." Now the *condition* of the organic world was just what Darwin was trying to explain.

I have dwelt at some length on Morgan's work because I suspect that he is largely responsible for the attitude of Burroughs. But in the quotation just given Morgan admits a belief that Darwin's idea of selection is a most important contribution to the theory of evolution. After a somewhat relentless attempt to tear down most of Darwin's work, he allows his particular thing, *selection*, to stand with his approval; reluctantly and with reservation, it is true; but still to stand. It does not appear, then, that even the most iconoclastic of Darwin's critics would go so far as to regard Darwin as completely "shorn."

#### IV

A majority of naturalists are at present much impressed by the mutation theory and, if not fully convinced, are quite willing to be convinced of its truth. But it is also true that most of them are both Darwinians and mutationists, a position in which they but follow the lead of the master mutationist, De Vries. A still larger number of biologists are willing to subscribe to a belief in the Mendelian theory; and here, too, there is no quarrel with the idea of Natural Selection. The law of Mendel has given us a new insight into the mechanism of the germ cells and of heredity where Darwin had no means of pursuing his researches. But these more recent investigations have revealed nothing antagonistic to an acceptance of Natural Selection, which can now be regarded as a selection of the fittest mutants. And here again we must insist that the mutants of De Vries should properly be regarded as included in the individual variations of Darwin, with the exception of the very pronounced mutations, such as those of the evening primrose, which would have been regarded as "saltatory evolution" by earlier naturalists.

Such authorities as Castle and Jennings believe in Mendelism, but not in mutations. These also are far from believing that natural selection has been discarded.

Another writer who doubtless contributed ammunition for Mr. Burroughs' assault on Natural Selection is Professor H. F. Osborn, one of America's leading paleontologists. He also, it seems to me, does not deal quite fairly with the author of the "Origin," for he says: "Chance is the very essence of the original Darwinian hypothesis of evolution." In view of Darwin's frank and explicit explanation of his use of the word "chance," it is inexact, to say the least, to insist on a literal use of the word which he expressly disclaims and emphatically disavows. I do not believe, moreover, that Professor Osborn would fully endorse the unqualified statement regarding the shorn condition of Darwin; for he distinctly admits the importance of Natural Selection in his book "The Origin and Evolution of Life." He says:

"Upon the resultant actions, reactions and interactions of potential and kinetic energy in each organism selection is constantly operating." Again he says, and still more explicitly: "Whenever such changes of proportion weigh in the struggle for existence they may be hastened or retarded by Natural Selection."

As a matter of fact it is very doubtful if any leading zoologist would at the present time be willing to make so positive a statement as has John Burroughs regarding the "shorn" condition of Darwin so far as Natural Selection is concerned. Practically all of them regard Natural Selection as an important contribution to our understanding of organic evolution.

## V

Indeed I must confess to a degree of skepticism regarding the mental attitude of the distinguished author of "A Critical Glance into Darwin" himself, for there are some rather glaring inconsistencies in his paper. After declaring the shearing process complete he finds himself unable to get along without appropriating some of the shorn locks to his own use. For instance: "And though I believe that *the accumulation of variations is the key to new species*, this accumulation is not based upon outward utility but on innate tendency to development." The italics are mine. No one, so far as I know, has proposed any method by which an accumulation of variations can be brought about except by the action of Natural Selection.

Again, he says: "Natural Selection turns out to be of only secondary importance—Natural Selection gives speed where speed is the condition of safety, strength where strength is the condition, keenness and quickness of sense-perception where these are demanded." Such expressions seem to indicate that Natural Selection functions in some

rather important matters after all, indeed that it is of at least secondary importance.

After criticising Darwin for presenting an anthropocentric view of Nature, he naively remarks that it (Natural Selection) "is Nature's way of improving her stock." Just the picture that Darwin drew!

But, as it seems to me, he practically abandons his whole case when he says: "What I mean to say is that there must be some primordial tendency to development which Natural Selection is powerless to beget. It can not give the wings to the seed, or the spring, or the hook—*but it can perfect all those things. The fittest of its kind does stand the best chance to survive.*" Again, the italics are mine.

Now if there be any one thing about which all biologists and physicists are in thorough agreement, it is the belief in the uniformity and continuity of law in the universe. All believe that Nature's laws have worked in the past just as they are working now. In other words, if Natural Selection is at present engaged in perfecting animals and plants, she has been doing just that thing throughout the ages since life first appeared.

But we must remember that, although this perfecting is continuous, the standard of perfection is constantly changing. Perfection is always relative and never absolute. The first true winged bird, the *Archeopteryx*, was doubtless a very imperfect, even crude, creature according to our notions; but it was in its day an immense advance over its competitors and the best animated flying-machine of its time. It was practical, too. It did the business of flying better than any of its rivals. It was fittest to survive and it did survive, in its modern descendants, from far-away Jurassic time to this. And during all these countless centuries Nature has been at work "perfecting" this uncouth creature; keeping its descendants, or some of them, ahead of the game and thus making it perpetually the "fittest." And from this absurd creature have "radiated" as Osborn would say, various sorts of winged creatures each adapted to its manner of life or environment. These radiating lines ended in such marvels as the man-o'-war bird, that master acrobat of the air; and that dainty flying jewel, the humming-bird, poised apparently motionless in space; and, in short, all of the aerial artists that we call birds.

One can not help wondering just what Burroughs' position is when he says: "They (organic beings and structural changes) are adaptive from the first. They do not need Natural Selection to whip them into shape," and then declares: "Natural Selection perfects" these things. It seems that the same agency does not "whip into shape," but it does "perfect" things. This leaves us somewhat dazed.



## VI

What appears to bother Mr. Burroughs most of all is the seeming lack of any directive force in the process of evolution. He balks, as countless others have, at the idea that "This is a world of chance into which Darwin delivers us," and adds: "What can the thoughtful mind make of it?" Darwin himself balked at it, but was honest enough to admit that he saw no way out of the dilemma, and others have had like experience. Some sort of orthogenesis has appealed to many; but the trouble is there is little to prove its existence, however devoutly we may desire such proof. Darwin was too intensely honest in his intellectual processes to incorporate any such idea without some sort of evidence that would appeal to him as likely to carry conviction; but he found none, nor has any one else, so far as I can see. Can we doubt that he would have gladly welcomed and used such proof, had it been forthcoming?

What is Burroughs' proposal by which he seeks to satisfy this longing for something better than a world of chance? He says: I am persuaded that there is something immanent in the universe, pervading every atom and molecule in it, that knows what it wants—a cosmic mind or intelligence."

This must be pantheism, if I understand it at all; but there is little that is soul-satisfying about pantheism, and a religion that does nothing for the soul is poor stuff. Moreover, such a belief has no scientific sanction.

The groping of the thoughtful mind for some directive force in evolution, whether in the form of an entelechy, orthogenesis, predetermination, Providence, or the "horse impulse" of Burroughs, has in it something of pathos and reminds one of the statue to "the Unknown God" at Athens; but thus far there has appeared no Paul to make him known unto us. I am sure that Darwin would have welcomed him, but would have demanded some rather convincing credentials. The God that Paul did propose to the Athenians answers, in the minds of Christian evolutionists (and there are many of us) to the God of the second moollah in Burroughs' article for "He is so wise that he makes all things make themselves."

But it is utterly unnecessary to inject pantheism or any other first cause into a discussion of Natural Selection. Darwin did not attempt anything of the sort and therein showed his wisdom. He found that there are three fundamental laws of living things, each so obviously true as to be axiomatic. Nor was it germane to his purpose to go back of these laws and discuss ultimate causes. He simply took the world as he found it and explained how diversity of species had been brought about. The three laws are:

1st. *The Law of Heredity*, which works to make the progeny resemble their parents. No one doubts the *fact* of heredity whatever its mechanism may be. Darwin did try to imagine a sufficient mechanism and called it "pangeneses." This theory has been largely discarded; but, whether true or false, it has little direct bearing on the theory of Natural Selection, nor could it invalidate that theory in the least. This law is the *conservative* factor.

2nd. *The Law of Individual Variation*. No one doubts that this is a fact, whether he calls the variations "individual variations," "fluctuating varieties" or "mutations." They are all simply variations in the Darwinian sense. Darwin did not explain the origin of variations, nor did he need to. I have little sympathy with those who exclaim that "Natural Selection originates nothing" because it does not tell the cause of variation. When we contemplate the bewildering complexity of the germplasm and the countless hereditary possibilities in each germ cell, the wonder is not that there is variation, but that it is kept within such reasonable limits. This law is the *qualitative* factor of organic evolution, furnishing differences from which selection may be made.

3rd. *The Law of Geometrical Ratio of Increase*, by which every species tends to over-populate the earth if its natural ratio is not checked. No one doubts that this is a fact. Indeed it seems to have furnished both Darwin and Wallace with the key with which they each solved the problem of the origin of species. This law is the *quantitative* factor, furnishing great numbers from which to select.

Having stated these laws and discussed them at length, Darwin set himself the task of ascertaining how they would act and interact in Nature, and found that the necessary result of such action and interaction would be a *selection* that would result in more and more perfect adaptations to environments and the elimination of the unfit, thus assuring the survival of the fittest or most perfectly adapted forms, and a general advance in complexity and specialization of species. He compared this selection to the artificial selection wrought by man in improving his domestic animals and called it "Natural Selection." It seems to me puerile to object to this comparison, for Darwin pointed out in the most painstaking way the essential differences between the two. They are comparable in a large and true sense.

That a selection of some sort could result from the combined working of these three laws can not be successfully denied, and it was Darwin who proved this to the world. And no name has been proposed for this selection that is more satisfactory to biologists as a whole than "Natural Selection."

The logic of this course of reasoning seems to me and to many of my zoological, botanical and geological colleagues, unanswerable.

I feel very sure that a large majority of those professionally engaged in the study of biological science would answer the question: "Is Darwin completely shorn of his selection doctrines?" by a decided negative. Some of his ideas have been trimmed to suit the prevailing mode of thought and more complete knowledge; but he is not "shorn."

In conclusion I must venture to express the hope that the honored friend of Nature, John Burroughs, will not allow an incursion into the field of tonsorial art to divert his attention from that exquisite art with which he has so often delighted an innumerable host of sincere admirers. There are controversial writers galore, and in every field of thought; but few indeed are they who do the work of observing and depicting the lives and habits of our familiar friends of orchard, field and forest with so keen an insight and so sure and felicitous a touch.